

**REMARKS**

Claims 1-10 are pending in this application. Claims 6-9 are currently withdrawn.

Applicant respectfully requests reconsideration of the pending claims.

**I.      Interview**

The courtesies extended to Applicant's representative by Examiner Listvoyb at the interview held February 11, 2009, are appreciated. The reasons presented at the interview as warranting favorable action are incorporated into the remarks below, which constitute Applicant's record of the interview.

**II.     Rejections Under 35 U.S.C. §103(a)**

**A.      Claims 1-5 and 10**

Claims 1-5 and 10 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent No. 4,308,374 ("Vollbracht") in view of RU 2017866 ("Chernykh") and in further view of U.S. Patent No. 5,646,234 ("Jung"). Applicant respectfully traverses this rejection.

The Patent Office alleges that it would have been obvious to one of ordinary skill in the art to have taken the polymers disclosed in Chernykh and Jung and expanded the applicability of these polymers using the technology disclosed in Vollbracht. See Office Action, page 5. Applicant respectfully disagrees.

Specifically, although Vollbracht describes forming a crumb during the copolymerization, Vollbracht describes forming a crumb using entirely different reaction materials from the materials recited in the present claims. Furthermore, Chernykh or Jung do not disclose a crumb, as the processes disclosed in Chernykh or Jung directly process a polymer from a solution. Nothing in any of the references would have led one of ordinary skill in the art to have modified the compositions described in Vollbracht, Chernykh or Jung to the composition of claim 2 with any reasonable expectation of success in being able to

obtain the composition in crumb form. Nor would the references have led one of ordinary skill the art to the process of claims 1 and 10, as the references fail to describe how to obtain the composition in crumb form as recited in claim 2.

1. **Vollbracht**

Vollbracht describes a method of producing an aromatic polyamide ("PPTA") crumb using para-phenylenediamine ("PPD") monomers and terephthaloyl dichloride ("TDC") monomers in a N-methyl pyrrolidone/calcium chloride ("NMP/CaCl<sub>2</sub>") solvent/salt combination. See Vollbracht, col. 1, lines 53-60 and the Abstract. PPTA crumbs are known and highly desired as the purification of crumbs is relatively easy and the processability is high. See page 2, lines 10-11 of the specification. As described in the First Set of Experiments in the attached Rule 132 Declaration – which represent the embodiments described in Vollbracht – varying the concentration of PPD and TDC monomers and the weight percentage of CaCl<sub>2</sub> produces a PPTA crumb with an inherent viscosity ( $\eta_{inh}$ ) that was always greater than 3.

Vollbracht does not describe replacing a portion of the PPD with 5(6)-amino-2-(p-aminophenyl)-benzimidazole ("DAPBI"). Specifically, Applicant alone has determined that if a portion of the PPD is replaced by DAPBI, the proper ratio of PPD, DAPBI and calcium chloride must be used or the aramid polymer will not form a crumb, but a sticky paste, dough or powder. See page 2, lines 21-22 of the specification. As such, none of the references describe (1) the modification of PPD with DAPBI to form a crumb and (2) the amounts of PPD, DAPBI and calcium chloride required to obtain a crumb. Thus, it would not have been obvious to one of ordinary skill in the art to have combined the teachings of Chernykh with Jung to form the crumb obtained in Vollbracht using a different composition.

**2. Chernykh**

The Patent Office alleges that Chernykh discloses a method for producing an aromatic polyamide (aramid) comprising para-phenylene terephthalamide and 2-(p-phenylene) benzimidazole terephthalamide units by copolymerizing: (1) 10-80 mole percent of PPD, (2) 10-80 mole percent of DAPBI, and (3) 100 mole percent of TDC in a mixture of NMP and calcium chloride or lithium chloride. See Office Action, page 4, citing Chernykh, Example 1. Applicant respectfully disagrees.

As admitted by the Patent Office, Chernykh does not describe a crumb obtained directly by copolymerization because the processes described in Chernykh maintain the reaction in solution after polymerization and directly use the solution to form a spin dope. See Office Action, page 5.

**a) Chernykh Would Not Have Provided One With Any Reason or Rationale To Have Replaced A Portion of PPD With DAPBI And Form A Crumb**

One having ordinary skill in the art, starting with the teachings of Vollbracht, would have understood that crumbs are not formed when PPD is replaced by a portion of DAPBI. Such a person, in looking for a solution to this problem, would not have been provided with any reason or rationale from Chernykh or Vollbracht to have combined these references. Chernykh's description of forming a solution by substituting a portion of PPD with DAPBI would have directed one to have believed that a crumb could not have been formed by this substitution.

Furthermore, Chernykh does not describe the conditions as presently recited in claims 1, 2 and 10. Example 1 of Chernykh discloses a method for producing an aromatic polyamide by copolymerizing: (1) 40 mole percent of 2-chloro-para-phenylenediamine (Cl-PPD); (2) 60 mole percent of DAPBI and (3) 100 mole percent of TDC in a mixture of anhydrous N,N-dimethylacetamide ("DMAc") and lithium chloride.

In contrast, claim 2 of the present application recites an aromatic polyamide containing para-phenylene terephthalamide and 2-(p-phenylene)benzimidazole terephthalamide units, in the form of a crumb, obtained directly by copolymerizing para-phenylenediamine; 5(6)-amino-2-(aminophenyl)benzimidazole; and terephthaloyl dichloride in a mixture of N-methyl pyrrolidone and calcium chloride, wherein the aromatic polyamide in the crumb has a relative viscosity  $\eta_{rel}$  of at least 4, and wherein the crumb is defined as non-sticky particles at least 95% of which having an average diameter of 0.7-15 mm.

Also, claim 1 of the present application recites a method for obtaining an aromatic polyamide containing para-phenylene terephthalamide and 2-(p-phenylene)benzimidazole terephthalamide units, in the form of a crumb, by copolymerizing: i) a mole % of para-phenylenediamine; ii) b mole % of 5(6)-amino-2-(p-aminophenyl)benzimidazole; and iii) 90-110 mole% of terephthaloyl dichloride in a mixture of N-methyl pyrrolidone and containing c wt.% of calcium chloride, wherein c is within the range from 1 to 20, and wherein the ratio a : b ranges from 1 : 20 to 20 : 1, a + b is 100 mole%, and i), ii), and iii) together comprise 1-20 wt.% of the mixture, wherein the product b.c is at least 50 and less than 215 and the aromatic polyamide in the crumb has a relative viscosity  $\eta_{rel}$  of at least 4, wherein the crumb is defined as non-sticky particles at least 95% of which having an average diameter of 0.7-15 mm, and wherein the crumb is formed directly by the copolymerizing.

Thus, the composition and method disclosed in Example 1 of Chernykh are different than the composition and method recited in the present claims. Example 1 of Chernykh discloses (1) a different phenylenediamine (Cl-PPD vs. PPD), (2) a different salt (lithium chloride v. calcium chloride) and (3) a different solvent (DMAc v. NMP) than required in claim 2 in order to obtain a crumb form of the composition. As such, one having ordinary skill in the art would have been required to have performed numerous substitutions to have arrived at the subject matter recited in claim 1.

**b) The Conditions For Obtaining A Crumb Directly During The Copolymerization Are Not Described In Chernykh**

The copolymerization of PPD and TDC leads to a PPTA crumb. However, the present application embodies the scenario when a portion of PPD has been replaced with DAPBI. Prior to the present application, such a replacement formed a powder compound or a gel compound, which has been a serious problem for large-scale production of a DAPBI-containing aramid.

As described in the Fifth Set of Experiments in the Rule 132 Declaration, forming a PPTA aramid crumb using PPD, DAPBI and TDC monomers requires a specific set of conditions. The Fifth Set of Experiments includes Applicants' reproductions of Examples 1, 4 and 7 of Chernykh. As shown in Table 6 of the Rule 132 Declaration, Examples 1, 4 and 7 describe the formation of a PPTA polymer solution using (1) Cl-PPD or PPD, (2) DAPBI and (2) DMAc alone or in combination with LiCl. As such, this evidence confirms that the Examples of Chernykh do not form a crumb. Those having ordinary skill in the art would not have succeeded in forming PPTA crumbs using the NMP/LiCl described in Chernykh instead of the NMP/CaCl<sub>2</sub> described in the present claims.

Such a conclusion has been confirmed (1) by Example 4 of U.S. Patent No. 4,018,735 (Nakagawa) detailing the formation of a semi-transparent aramid dope (i.e., a solution) from the reaction of PPD, DAPBI, and TDC monomers in a LiCl/NMP salt/solvent combination and (2) by Example 34 of U.S. Patent No. 4,172,938 ("Mera") disclosing the formation of a powder because of the b.c value is not within the range recited in claims 1 and 10.

To demonstrate the difficulty in obtaining a crumb from a DAPBI polymer, Applicant performed two additional sets of experiments to show that crumbs are formed if the components and conditions recited in present claims 1 and 10 are satisfied. These two sets of experiments are characterized as the Sixth and Seventh Set of Experiments in the Rule 132

Declaration, wherein the results of these experiments are illustrated in Table 7 and Table 8 of the Rule 132 Declaration, respectively. The Sixth Set of Experiments is represented as Examples 1-7 as described on page 5 of the present specification and the Seventh Set of Experiments is represented as Comparative Examples 1-5 also described on page 5 of the present specification.

As shown in Table 7 of the Rule 132 Declaration, the experiments (Experiments 1-7) of the Sixth Set of Experiments each contain (1) amounts of PPD ranging from 30 to 90 mole%, (2) amounts of DAPBI ranging from 10 to 70 mole% and (3) amounts of calcium chloride ranging from 2.82 to 11.55 wt%. Furthermore, each of the compositions for these experiments formed a crumb directly during copolymerization due to each composition possessing an inherent viscosity of at least 4.0.

Furthermore, shown in Table 8 of the Rule 132 Declaration, if one alters (1) the mole% of DAPBI (b) in a range from 20 to 67 mole% and (2) the weight percent of calcium chloride (c) in a range from 1.96 to 11.55 wt%, then a crumb will not be formed, but a dough/paste, gel or powder will be formed. Such products are less suitable for forming aramid fibers and films in a commercial scale production. This evidence demonstrates that although the ranges of DAPBI and calcium chloride shown in Table 8 are similar to those shown in Table 7, the value of the mole percent of DAPBI (b) multiplied by the weight percent of calcium chloride (c) is essential in determining whether a crumb will be formed.

As such, one will conclude that replacing a portion of the PPD monomer with DAPBI monomer in NMP/CaCl<sub>2</sub> will not form a crumb under reaction conditions that are different from the conditions recited in claims 1 and 10 of the above-identified application. In other words, crumbs obtained using these materials require a very specific relationship between the amounts of DAPBI and of CaCl<sub>2</sub>, none of which are described in Chernykh.

c) **The Patent Office's Allegation That Chernykh Describes The Equivalence Of LiCl And CaCl<sub>2</sub> Would Be Applicable To Crumb Formation Is Incorrect**

The Patent Office alleges that Chernykh describes that the use of LiCl and CaCl<sub>2</sub> is equivalent. See Office Action, page 4. Chernykh mentions the use of "CaCl<sub>2</sub> or LiCl", but does not reference what the term "or" actually means. Chernykh's use of the word "or" does not mean that if one replaced CaCl<sub>2</sub> with LiCl, all properties and effects of the polymer remain the same. For example, the viscosity of the polymer solution, the relative viscosity of the polymer, etc., can each be different. Thus, the term "or" in Chernykh cannot be interpreted as meaning that both salts can be used interchangeably without altering the properties of the polymer.

As described above, Chernykh only relates to polymer solutions, where the addition of CaCl<sub>2</sub> or LiCl enhances the ability of the dissolving power of polymer. As such, any interchangeability between CaCl<sub>2</sub> or LiCl only relates to conditions to obtain polycondensate solutions. But lithium chloride and calcium chloride behave differently when used to form an aramid crumb, and thus cannot be interchanged successfully as allegedly by the Patent Office.

Attached herewith is a Rule 132 Declaration that contains four sets of polymerization experiments to show calcium chloride and lithium chloride are not equivalent as compounds for forming an aramid crumb.

The First Set of Experiments in the attached Rule 132 Declaration describe varying the concentration of PPD and TDC monomers and the weight percentage of CaCl<sub>2</sub> in the NMP/CaCl<sub>2</sub> used to form the PPTA polymer. As shown in Table 1 of the Rule 132 Declaration, this variance always resulted in a PPTA polymer with an inherent viscosity ( $\eta_{inh}$ ) greater than 3 and thus the variance did not affect the formation of a PPTA crumb.

The Second Set of Experiments in the Rule 132 Declaration was performed in the exact same manner as the First Set of Experiments, except that CaCl<sub>2</sub> was replaced with other

salts, including lithium chloride. As shown in Table 2, the addition of LiCl only resulted in an inherent viscosity of 0.30, whereas the addition of calcium chloride (as shown in Table 1) unexpectedly achieved a substantially greater inherent viscosity to enable crumb formation.

The Third Set of Experiments in the Rule 132 Declaration describes that crumb formation also depends upon (1) the monomer concentration and (2) salt concentration. As shown in Table 3 of the Declaration, the final products of the Third Set of Experiments had an  $\eta_{inh}$  between 0.38 and 0.63 and thus formed a turbid yellow to a brown syrupy mass instead of a crumb.

The Fourth Set of Experiments in the Rule 132 Declaration was performed in the exact same manner as the First and Second Set of Experiments, except that the LiCl and CaCl<sub>2</sub> salts were combined with a dimethyl acetamide (DMAc) or NMP solvent. As shown in Table 4 of the Rule 132 Declaration, the NMP/CaCl<sub>2</sub> solvent/salt combination had an  $\eta_{inh}$  value of 4.31 and thus formed a crumb. But the remaining solvent/salt combinations, including (1) LiCl/DMAc (described in Example 1 of Chernykh), (2) CaCl<sub>2</sub>/DMAc and (3) LiCl/NMP, each formed a solution comprised of low molecular weight materials and possessed too low of an inherent viscosity to form a crumb directly during the copolymerization.

The four sets of Experiments in the Rule 132 Declaration demonstrate that the formation of PPTA from TDC and PPD monomers in a CaCl<sub>2</sub>/NMP solvent/salt combination renders a sufficient inherent viscosity to form a PPTA crumb. Yet the replacement of the CaCl<sub>2</sub> solvent with a LiCl solvent does not render a sufficient inherent viscosity to form a PPTA crumb. As such, the four sets of experiments in the Rule 132 Declaration confirm that LiCl and CaCl<sub>2</sub> are not equivalent and cannot be used interchangeably when the desired final product is a PPTA crumb.

**d) The CaCl<sub>2</sub>/NMP Salt/Solvent Combination Described In Table 2 Of Chernykh Is Directed To A Different Chemical Compound Than Recited In Claims 1 And 10**

The CaCl<sub>2</sub>/NMP salt/solvent combination described in Table 2 of Chernykh is directed to a benzothiazole derivative and thus would not have provided one with any reason or rationale to have used the same salt/solvent combination in the benzimidazole derivative described in claims 1 and 10.

The Patent Office alleges that Table 2 of Chernykh describes the combination of NMP and CaCl<sub>2</sub>. See Office Action, page 4. Applicants respectfully disagree.

Table 2 of Chernykh – referring to Example 5 of Chernykh – describes a benzothiazole derivative (5-amino-2-p-aminophenylbenzothiazole (DAPBT)) instead of the benzimidazole derivative (i.e., DAPBI) recited in claims 1, 2 and 10. However, the present claims are limited to DAPBI-containing aramids (not DAPBT aramids). Furthermore, the thiazole compound described in Chernykh possesses a much different functionality and/or characteristics than the imidazole compounds recited in the present claims.

As such, the Patent Office's contention that the solvent/salt combination (NMP/CaCl<sub>2</sub>) used for forming of DABPT-containing aramids would not apply to the DAPBI-containing aramids recited in claim 1-10. Such a contention is entirely unsupported by the disclosure of Chernykh.

**3. Jung**

The Patent Office alleges that Jung discloses a method for producing a polyamide by the polycondensation of 100 mole percent TDC, 60 mole percent DAPBI (a) and 40 mole percent PPD (b) in NMP where the sum of a and b is 100 mole percent and relative viscosity is 4.3. See Office Action, page 4, citing Jung, Example 8. Applicant respectfully disagrees.

Jung also fails to describe the composition of claim 2, a composition in crumb form, or how to obtain the composition of claim 2 in crumb form by the use of the process (solvents and amounts of materials) of claim 1 and claim 10. According to processes described in claims 1 and 10, the polymer should not remain dissolved in the solvent (i.e., a solution) nor precipitate from the solvent. In contrast, the processes described in claims 1 and 10 should form a dough or "liquid cheese-like" material, which becomes a crumb upon further stirring.

The Patent Office alleges that Jung describes that use of a solubility promoting additive such as  $\text{CaCl}_2$  can be added to the polycondensation mixture. See Office Action, page 5. Further, as admitted by the Patent Office, Jung does not describe the formation of a crumb directly by copolymerization, but the formation of PPTA polymer solutions. See Office Action, page 5.

Because Jung merely describes the formation of PPTA polymer solutions, one having ordinary skill in the art, wishing to obtain a crumb during copolymerization, would not have added a solubility-promoting additive. Such a person would expect that the inclusion of solubility promoting additive would form a soluble polymer (i.e., a solution) rather than a sticky paste that converts to an insoluble crumb upon additional stirring. As such, an individual confronted with the teachings of Vollbracht and desiring to form a crumb would not have been provided with any reason or rationale from Jung, but instead would have searched for another solvent that does not dissolve the final PPTA polymer.

As such, one having ordinary skill in the art having the desire to form a crumb directly during copolymerization, would not have added an alkali metal salt or an alkaline earth metal salt because Jung (and Chernykh) describe that such addition increases the solubility of the polymer to form a solution, not a crumb.

**4. Conclusion**

As such, none of the references describe (1) the composition in crumb form as recited in claim 2 or (2) the method to make the composition in crumb form as recited in claims 1 and 10. In view of the above arguments, Applicant respectfully requests withdrawal of the above 35 U.S.C. §103(a) rejection.

**B. Claims 2-5**

Claims 2-5 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Chernykh in further view of Jung and in still further view of Vollbracht in combination with Encyclopedia of Pol. Sci. and Tech, Polyamides, vol. 3, p. 565-567 ("Encyclopedia"). Applicant respectfully traverses this rejection.

For the reasons described above, Chernykh, Jung and Vollbracht do not describe the subject matter recited in claim 2. Encyclopedia does not remedy the deficiencies of these references. Encyclopedia, cited by the Patent Office as allegedly suggesting the composition of claims 2-5, actually illustrates why the references would not have led one of ordinary skill in the art to the present claims.

Encyclopedia, similar to Vollbracht, merely discloses that the copolymerization of PPD and TDC leads to a PPTA polyamide in the form of a crumb. See Encyclopedia, page 565, lines 14-20. However, Encyclopedia does not describe replacing a portion of the PPD with DAPBI. No specific requirements to make a crumb must be met when using PPD alone as in Encyclopedia as illustrated above in the First Set of Experiments in the Rule 132 Declaration.

Thus, it would not have been obvious to one of ordinary skill in the art to have combined the teachings of Chernykh with Jung to form the crumb obtained in Vollbracht and Encyclopedia using a different composition.

Withdrawal of the rejection is respectfully requested.

**III. Rejoinder**

In view of the foregoing amendments and arguments, Applicant respectfully requests that upon allowance of claims 1-5 and 10, claims 6-9 be rejoined with the present application and similarly allowed.

**IV. Conclusion**

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 1-10 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,



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WPB:JDT/hs

Attachment:

Rule 1.132 Declaration with Polimery Publication

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